

## LANDUSE AND ENVIRONMENTAL CHANGE IN THE LAKE CHAD BASIN OF NIGERIA

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### Introduction

The Lake Chad Basin is a major geographical region in the central part of the Sudan zone of Africa. The northern parts, however, extend into the Sahel and the southern parts of the Sahara desert. It consists of an extensive shallow depression of about 1.536.000 km<sup>2</sup> (600.000 miles<sup>2</sup>) of which about 10% lies in Nigeria. The greater part is shared between the three countries of Cameroon, Chad and Niger. Climatically and agriculturally, the Chad Basin lies within the dry or semi-arid zone of Nigeria. It is a marginal area which has experienced severe droughts and considerable environmental changes in recent years.

The natural environment, its use and misuse, and the threat of life posed by environmental pollution dominate discussions on environmental change. But in addition to the natural or physical environment, there are other equally important 'environments' which deserve some attention in view of the role that they play in generating economic growth and in ensuring sustainable development which is the central issue in our concern about the environment. These other environments are the cultural environment, the political environment and the economic environment, both internal and external. In the Chad Basin, all these other environments, along with the natural environment have been greatly influenced by its land locked location in the heart of Africa.

As a result of its location far away from the Atlantic Ocean, but close to the Sahara desert, the climate of the Chad Basin is hot, dry and dusty for most of the year. Fortunately, the Chad depression has created an inland lake which is fed by rivers originating from wetter climatic regions in Nigeria and Cameroon. The political and cultural environment is also greatly influenced by the fact that the Chad Basin is the meeting point of the Arabs of North Africa and the Sudanese negro groups of West and Central Africa. The open landscape, with no major physical barriers has continued to facilitate troop movements by rival warring groups and the extensive destruction of settlements and population during these inter group wars. It has also subjected the region to destructive desert storms such as that of May 30th, 1988 which blackened out the Maiduguri area for over one hour at about 3.00 PM.

The land pilgrimage routes from West Africa to Mecca pass through the Chad Basin; and so does the eastern trans-Saharan caravan route from

Yola, through Kukawa and Bilma to Tripoli. Continuous movements along these routes have resulted in considerable racial intermingling. These movements have contributed towards inter-group struggles for political ascendancy and political instability, especially in the Republic of Chad. In the Nigerian section which includes Borno, Yobe, Jigawa and parts of Bauchi and Kano states the types and pattern of land-use especially where large scale irrigation is carried out, have been influenced by political developments which have favoured large scale investments in water development projects and the creation of new states.

## Population and the Environment

The growing interest in and the increasing concern about landuse and the environment are tied up with the wider issue of sustainable development. It is the extensive exploitation of the organic environment by man for his survival that has caused the depletion of such resources as soils, water, trees, animals and minerals. Population pressure on resources is therefore a key issue in the environment debate. Government concern about the situation in the country, including the Chad Basin is presented in section 3.14 of the 1988 National Policy on Population which observes that:

"The present high rate of our population growth is already contributing substantially to the degradation of the ecology of the country. Land fragmentation, over farming, and over grazing have led to soil erosion and desertification ...If the present rapid population growth continues, this situation of the environment and life will worsen (LAGOS, 1988).

The natural, political and socio-economic environments of the Chad Basin in Nigeria have attracted more population and large scale investments in farming during the past thirty years. Refugees from the Republic of Chad, which continues to suffer from political instability and intergroup warfare, and from severe droughts in Niger Republic, have continued to move into Nigeria, especially after the Sahelian droughts of 1972-1974. The demand for suitable agricultural land has therefore increased greatly, since much of the region has itself experienced severe droughts and other environmental hazards during this period.

The Kanuri, numbering about 1.5 million, make up the largest ethnic group in the Nigerian part of the Chad Basin (they are thought to be of mixed Arab, Kanembu and Tubu descent). Kanuri make up the ruling group in Borno, and most of the original indigenous groups that they had conquered have since adopted the Kanuri language. In turn, the Kanuri have become gradually merged with these groups. Small pockets of pure Kanembu people are found in the Kukawa and Monguno districts. Arabs, whom the Kanuri call Shuwa, make up the second largest group, and are found in the eastern part of Borno.

During the past five hundred years of their settlement in the Chad Basin, the Shuwa Arabs have lost most of their ethnic traits, except their language. Of greater importance for this presentation is the fact that they have displayed a remarkable adjustment to the natural environment which was more humid when the Shuwa arrived as nomadic herdsmen over 500 years ago. Since the climate was not suitable for breeding camels which formed the basis Shuwa Arab existence as desert nomads, they were obliged to adopt cattle rearing. A combination of recurring drought and cattle diseases later resulted in the decimation of the cattle population. Thereafter the Shuwa adjusted further and settled down as hoe cultivators; and have since become well known for practising a rudimentary form of mixed farming.

In the western and southern part of the Chad Basin, the Hausa form the predominant indigenous population. They are also settled hoe cultivators who own cattle which they put under the care of the nomadic cattle Fulani.

Other indigenous groups include the Gamergu, a small group in the middle Yedseram valley who rear cattle and horses and the Mobber of the lower Yobe valley. Smaller groups including the Margi, and the Kilba, occupy the hilly country west of the Mandara mountains where many hill settlements still exist. The most ubiquitous ethnic group in the Chad Basin are the Fulani, who are a relative newcomer to the region. The greatest concentration of the Fulani are in the Hadejia-Nguru wetlands, the Yobe valley and parts of Bauchi State.

Culturally, the Chad Basin has been a Muslim stronghold for many centuries. It is on record that Borno was an established Muslim state long before the Fulani Jihad that swept through parts of the Nigerian Sudan. Today the Kanuri and the Shuwa Arabs continue to practice a liberal form of Islam in which women are allowed to participate in public affairs. The population of the entire region was diminished during the late 18th and early 19th centuries, as a result of recurring warfare between the rival states of Borno, Waday and Bargimi. Further, the long standing strained relations between Borno and the Sokoto caliphate became worse during the 1850's, when Borno assisted the rebel governor of Hadejia against the caliphate. The Hausa-Borno borderlands where the wetlands are located became a zone of warfare and general insecurity. As a result of these warfare, many localities which Barth (1857a, 544; 1857c, 582) had described as flourishing and populous in 1851, were "reduced to a state of ruins and misery" three years later, after many people had been killed or carried away as slaves.

A thorough investigation of this pre-colonial period depopulation of parts of the Chad Basin is yet to be carried out. It appears that the loss of population and the abandonment of homesteads and waterpoints (wells) had a deteriorating effect on the ecological balance of the localities. Drier conditions appeared to have prevailed in many localities following the

termination of carefully tended *fadama* farms as well as upland farms and irrigated croplands relying on well water. This is so because as Mortimore (1989) has observed, dry season cultivation protects the soil from wind erosion. Resettlement during the early colonial period, when hostilities had ceased, was slow. Livestock grazing by nomadic herdsman continued, but grazing denudes the vegetation and exposes the soil to sheet erosion by wind and water. The accumulation of sand dunes follows and this leads to further impoverishment of the environment.

Climatic change in the Chad Basin has been a recurring theme that has attracted the attention of governments and environmentalists. The Sahelian drought of 1972-74 and the late 1980's brought to the fore once again the fear and threat of the southward extension of the Sahara desert. Droughts are a regular feature of the Chad Basin, and the inhabitants adapt to it in various ways. Crop failures resulting from drought have been compensated through the use of irrigation in favoured locations. The problem today is the increase in the occurrence of hydrological drought, in which both surface and groundwater levels have fallen below average. Other evidence of desertification, featuring the decline or destruction of the biological potential of the land, include the shrinking size of Lake Chad and the continuing fall in groundwater levels. These ecological processes are clearly attributable to human activities such as the damming of rivers, and abstracting water in upper reaches, for irrigation.

As a result of the low level of technology of the inhabitants and the harsh environment, food production has not kept pace with the increasing population. Famines occur frequently in years of late rains, prolonged meteorological drought, extensive floods and locust invasion. Governments have therefore sought to increase food production through modern irrigation schemes, including very large scale schemes. But irrigation has created additional problems of salination, alkalinity and water logging. More important, the future of the larger irrigation schemes is uncertain as Lake Chad, the source of water for some irrigation schemes continues to shrink. Indeed in the South Chad Irrigation Project and the Baga Polder Project, many irrigation canals have since been filled up with drifting sand dunes. Expensive equipment, the pumping houses, intake works and grain mills stand abandoned. As the lake recedes, the settlers move away from the marooned irrigated scheme areas to cultivate the lake floor. This is a unique case in which environmental change has created new land-uses on the lake floor on the same time that land-use featuring the damming of river to provide water for irrigation is also including permanent changes in the environment and resources of the Hadejia-Nguru wetlands.

## Environmental Change - General Considerations

The literature on drought and desertification in the Chad Basin and the continuing decrease in the size of Lake Chad present convincing evidence of the ongoing changes in the local environment. The dams built across some rivers have created new lakes while rendering sections of the rivers permanently dry. These, along with the sandstorms and live sand dunes provide additional evidence, while the numerous fossil dunes confirm, that these processes also occurred in the past. The causes of these changes are not so clear although human activities, especially farming, grazing and cutting fuel wood are thought to be dominant. The doubts about causes arise in part because there is an evidence that environmental change in the region is not uni-directional but cyclical. The fossil dunes for example suggest that there was a drier period, followed later by a wetter period, which is now getting drier once again.

Mortimore's recent study of farmers, famines and desertification in West Africa (MORTIMORE, 1989) confirms that the human factor is the main cause of environmental change in the Chad Basin. Four main causes or factors of environmental change are recognised, and these are:

- (1) reduced rainfall resulting in persistent meteorological and hydrological drought.
- (2) environmental misuse through land-use practises that are not conservation conscious.
- (3) population pressure on land, which is considered to be the direct cause of environmental misuse, and
- (4) external factors that cause structural changes in the local economy and society.

These four factors fall into two major categories namely, land use practices and 'natural' factors, notably reduced rainfall.

### Land Use Practices and the Environment:

Farming and animal rearing, the two main economic activities in the Chad Basin, are featured in the brief account already presented of the various ethnic groups that inhabit the region. Arable farming and livestock grazing along with the high and increasing demand for fuel wood have contributed greatly to environmental degradation. Population movements into the region from drought stricken areas of Niger and Chad Republic have created greater demand for farmland and grazing, particularly along the *fadamas*. Urban centres, notably Maiduguri and the newer state capitals of Damaturu and Hadejia make considerable demands on both the surface - and ground water resources. Indeed the construction of surface dams to provide water for people in these and

other towns has resulted in loss of dry season farmland to the people living downstream. Road construction using large earth moving machinery has created large scars on the landscape, often deliberately to serve as rain water collecting ponds for use by cattle. In many localities, such scars are the starting points of gully erosion.

The land use practices that effect the environment are cultivation, bush burning, grazing, deforestation and irrigation. The changes caused by these land use practices, especially cultivation is often positive because of careful adaptation by the inhabitants who have a vested interest in preserving their homesteads. It is the recent capital intensive irrigation projects that have created more dramatic changes on, and damage to the natural environment.

## Land Tenure

Land tenure, or the rights and obligations over land is an important component of the socio-political environment. It is known to play a critical role in the ways that land use practices bring about environmental degradation. Owner occupiers, for example, are known to be more committed to land conservation measures, than migrant tenant farmers. A brief reference to the land tenure systems in the Chad Basin is therefore in place.

As in other parts of northern Nigeria, land use in the Chad Basin is affected by African customary land laws as well as Islamic land law and English land law. English land law is confined to parts of the major urban areas. Elsewhere, land is held communally by the village community, whose head supervises the allocation of land for farming and building houses. Land so allocated reverts to the community when a dead occupier has no successor to inherit the land. Land transfer is mostly through inheritance, and partible inheritance under Muslim law has resulted in fragmentation of holdings. Often one farmer has more than three separate farms in different parts of the village territory.

Demand for farmland is greatest near to the main towns and along water courses where water is available for dry season cultivation of vegetables. Individual ownership has largely displaced communal tenure in the areas of great demand for land or areas of permanent cultivation.

## Arable Farming

Farming involves the killing of some trees during land clearance and bush burning. Firewood obtained during the clearing is needed for fuel. Land clearance when preparing farmland, exposes the surface soil to

water and wind erosion and there is an increase in wind speeds. In localised areas of permanent cultivation, such as the closed-farmed Kano districts, intensive application of manure produces more stabilized soil conditions. Shade trees planted around homesteads help to conserve the soils around villages, and so do the 'wind belts' planted near villages in the drier areas. However, repeated trampling by livestock and uncontrolled grazing by goats prevent ready regeneration vegetation in the fallows around settlements. Further, foot paths to water points have often initiated erosion gullies which may expand over the years to cause much damage.

The Chad Basin is a very sparsely settled area, and it appears that in some localities the degraded state of the environment is due more to lack of use of the land rather than over use. Effective use of limited water resources in the Kano region and in Israel shows clearly, how concentration of population can improve the state of the environment. Further, evidence from densely settled localities in the Chad Basin confirms that permanent cultivation encourages the protection rather than the destruction of trees. It is man that builds wells, plants and tends trees including fruit trees, wind breaks and fuelwood plantations. At the same time, a sparsely settled area permits the time-old system of shifting cultivation which pays little attention to conservation measures that allow the production potential to be maintained. Ester Boserup insists that population increase is a necessary condition of rural development. "A small and stagnant population" she argues, "is unlikely to get beyond the stage of primitive agriculture to a higher level of technique of cultural development" (BOSERUP 1965).

### Bush Burning

Mortimore (1989) states that bush burning is rare in the drier semi-arid zone of the Chad Basin owing to sparse vegetation cover. This is not correct because burning to encourage regeneration of succulent grass for cattle goes on every year. There are, however, hardly any trees or shrubs to destroy in many areas. In the more wooded areas further south, burning is carried out in the process of preparing farmland, during hunting and for regeneration of grass shoots. In all cases burning works to prevent the survival of dense woodland vegetation and thereby exposes the soil to desiccation and erosion.

### Livestock Grazing

The vegetation is scanty and the grass cover is seasonal, while patches and in some districts, extensive areas, remain bare of vegetation even

during the rainy season. The natural environment is disturbed by premature grazing, whereby animals eat up plants before they reach seed producing stage. Indeed during the dry season, bush burning takes place so as to induce regeneration of fresh grass to feed the cattle. Goats do more damage since they eat up the branches and shoots of plants, and even the barks in some cases. Trampling by livestock destroy vegetation and loosen the soils for the winds to blow away.

## Deforestation

Clearance of woodland for farming is a major cause of deforestation in the southern parts of the Chad Basin. In the drier northern parts, there is no woodland to clear. Traditional agriculture is less destructive to woodland, compared to mechanised farming which an increasing number of retired senior civil servants and army officers have established during the past twenty years. Clear felling involving the uprooting of most trees by machinery precedes the preparation of land for cultivation in these mechanised farms, some of which cover several thousand hectares.

The more prevalent causes of deforestation are wood cutting, lopping and burning. In the rural areas, virtually every family depends on firewood and charcoal as the main source of fuel; while 90% of urban families also depend on firewood for cooking. The shortage of firewood in the region is evidenced by the high prices for wood, especially in the towns and the use of animal waste as fuel for cooking food, instead as manures for producing food. Firewood is obtained mostly from farmlands and fallow bush. But in many districts trees and shrubs on such land have largely disappeared such that local inhabitants are forced to poach for firewood in protected forest and game reserves.

There is clearly a fuelwood energy crisis in many areas including the Local Government Areas of Geidam, Kukawa, Monguno and Nguru where woody stems are few and scattered. Surprisingly Mortimore (1989) considers the concern expressed over deforestation in an area as arid as the Manga Grasslands along the Nigeria-Niger border as alarming! He states that up to 1986, wood for construction or fuel was still not considered to be scarce in the Manga area of the Hausa-Borno borderlands between Matsena and Dagaceri. His argument is that rural fuelwood in the area is usually harvested from living trees, rather than by clear felling. He therefore concludes that those who talk about 'indiscriminate deforestation' are over-dramatising.

Deforestation caused by farmers and cattle rearers has certainly contributed to increased surface run off which is responsible for increased aggradation and silting up of river-beds. The rather broad river-valleys thus developed often give rise to extensive floods which like droughts, are destructive to crops. Deforestation is also considered to



be the cause of a dramatic development affecting the surface hydrology of the area between Potiskum and Damagum in Yobe State, where a rise in water table has resulted in the appearance of many new streams. Field reports by Carter and Barber (1956) in the Potiskum area indicate, that many erstwhile dry valleys now carry perennial flows and that there has been a rise of over 50 metres in the water level of wells in the district. Further, substantial lakes have been formed near Garin Hassan. The explanation given to this curious development is that the level of the water table is independent of the fluctuations in the rainfall, but related to extensive deforestation and cultivation of large areas. Deforestation and cultivation increase run off, while reducing evapotranspiration. Since the terrain is almost flat, loss of water by run off is minimal and does not cause a significant fall in the water table. Rather the run off enters the river systems which, being influent, are able to supply more water to the permanent ground water.

## Irrigation

Irrigation brings considerable modifications in the ecosystems of semi-arid and arid areas. Environmental changes are associated with irrigation schemes in which large dams are constructed to create artificial lakes. Often many settlements have to be relocated.

The large scale irrigation projects in the Chad Basin include the Kano River Project, which relies on water impounded by the Tiga dam. This gravity fed scheme for developing 24,000 hectares has made permanent cultivation of small farms (1-2 hectares) possible, which are serviced by centrally located tractor hire units. Cultivation is carried out during the rainy season as well as during the dry season. The Hadejia valley irrigation project depends on the release of water from Tiga dam and when fully operational will irrigate 84,000 hectares. But the Tiga dam is largely responsible for the drying up of a branch of the Yobe river. Today the river bed that provided water to irrigate the *fadama* farmland and fish for local fishermen has been taken over by sand dunes.

The South Chad Irrigation Project at Baga was commissioned in 1983 using water from Lake Chad via a 29 km long intake canal. By 1990 most of the canals had become derelict because of the continuous fall in the level of Lake Chad starting from 1972-74. The original supply canal was extended 24 km into the lake in 1979, but by 1986 the lake had dried up so much that the nearest water to the supply canal was 70 km away (ADAMS and HOLLIS 1987: 90).

Other important irrigation projects in the Chad Basin include the Yobe irrigation scheme and the Hadejia-Nguru wetlands schemes. There are also many smaller schemes which rely on water from rivers or pools in the river beds as well as on water obtained from wells. The failure of

large scale capital intensive irrigation schemes due partly to drought and partly to poor planning and management has turned attention increasingly to small-scale pump and *shadoof* irrigation.

Some of the advantages of large scale irrigation projects are offset by considerable loss of *fadama* agricultural land to water storage in artificial lakes. In the Kano River Project, the extensive areas of lush fields of wheat and vegetables during the dry season, when the non-irrigated areas consist of bare brown fallows, are remarkable evidence of the change that irrigation has brought to the cultural landscape of this part of the Chad Basin. In the area of the Chad Basin irrigation scheme, drought and the recession of Lake Chad have stultified the scheme, thereby creating what has recently been described as 'one of the outstanding monuments of the folly of big irrigation projects in Africa' (THE GUARDIAN 1992).

## Drought and Environmental Change

Reduced rainfall, resulting in meteorological and hydrological droughts is a major cause in environmental change in the Chad Basin. Rainfall variations effect both the surface water and ground water regimes. The types and intensity of land-use as well as the geological and soil conditions influence both the surface run off and the amount of water that sinks into the ground, and therefore the groundwater level. Rainfall data in the Chad Basin show clearly that there has been recent meteorological drought in the area since 1972. Like the earlier severe droughts of 1913, 1926 and the early forties, the recent droughts have resulted in a marked lowering of the watertable. The severe damage to vegetation and soils, and the loss of farmland to sand dunes have produced a large number of environmental refugees that now roam the streets of the very large urban centres even as far south as Lagos, Enugu, Ibadan, Port Harcourt and Benin City.

The continued shrinking of the size of Lake Chad is caused partly by drought and partly by loss of water to artificial lakes impounded by dams across rivers that supply the lake. The lake is a vast expanse of very shallow water. Before the 1972-74 drought the actual area under water varied from 10.000 to 26.000 km<sup>2</sup> according to the season of the year. It is most extensive between mid-December and January, which is a very dry period, because its waters come mostly from River Shari, flowing in from the wetter Guinea Savanna Zone. The depth is no more than 4 to 6 m and during the low water season (March to November) many mud and sandy islands emerge.

Since about 1970, the extent of the lake has been greatly reduced. Baga Ngelwa was a large lake-shore market in 1920, but by 1930 the market has ceased to exist because the water level had become too shallow to allow the approach of fishing canoes. By 1990, the lake had

receded so much that Baga Ngelwa was 15 km from the lake shore. Further, the fish market at Doro Gowon where I boarded a boat in 1970 to visit the Nigerian/Chad border along the lake, was about 13,5 km away from the lake shores in 1990. The dried lake floor had since been put under cultivation. In November 1990, when I visited the lake, the annual crops of millet and guinea corn on the lake floor had been harvested. And since this month was the onset of the lake high water season, the waters of the Lake Chad had started to spread out towards Doro Gowon.

The 1972-74 drought and that of the late 1980's have contributed to the lowering of the water table in many places. As a result of these droughts two of the three underground aquifer at average depths of 100 m, 300 m, and 600 m have been largely depleted in the neighbourhood of Maiduguri. Many *fadama* farmlands have become too dry to cultivate since the annual floods have stopped or been greatly reduced after the construction of dams upstream. It is quite clear that deliberate efforts by man to improve the economic well-being of the inhabitants of the Chad Basin through irrigation has backfired. The drop in water table has resulted in the drying up of the vegetation of some areas.

Charnley (1975) contends that the decline in the rainfall received in the West African Sahel between 1968 and 1973 was due to loss in vegetative cover, which in turn resulted in increased surface albedo. The loss in vegetative cover was attributed to over-grazing, wood cutting and over-cultivation during the 1950's and 1960's when the rainfall was higher than the average. The consequent increase in surface albedo led to an increase subsidence, sustained thermal equilibrium and lower rainfall.

Human activities have certainly contributed a lot to the incidence of drought (and even floods) in the Chad Basin. There is also abundant evidence of climatic variations in the region during the recent past. Drought and desertification in the rather ecologically precarious environment of the Chad Basin are therefore a product of both natural (climatic variations) and human activities of wood cutting, bush burning, farming, grazing and large scale irrigation in the marginal lands of the region.

## Environmental Change in the Hadejia-Nguru Wetlands

The Hadejia-Nguru wetlands provide a good case-study of the ongoing changes caused by human activities (land use) in the Chad Basin. Located within the quadrilateral formed by the towns of Hadejia, Nguru, Gashua and Katagum the wetlands consist of the flood plains of three rivers - the Hadejia, the Keffin Hausa and the Katagum rivers, which later combine to form the Komadugu Yobe. It is currently the most extensive agricultural and wildlife resource area in the Chad Basin and by far the most economically active rural area of its size in the Nigerian

Sahel. In this area of gentle relief with low hills made up of fossil sand dunes, the rivers divide into several channels and are subject to very extensive flooding during the rainy season when channel changes occur. But all these will soon be history as a result of marked changes caused by human intervention.

For centuries, the wetlands have been an important food producing area for the states of Kano and Borno. Currently it produces surpluses of rice, wheat and vegetables for many urban markets. It is a major livestock grazing area for the Cattle Fulani who usually move into the wetlands in September when the rainy season is over. Other important traditional economic activities include fishing and hunting. The diverse land uses of the wetlands feature dryland agriculture, *fadama* farmland, traditional irrigation fields using ditch and shadoof irrigation and modern irrigated fields relying on pump and gravity irrigation. Other typical land-uses in the wetlands include flooded grasslands, swamps which may be used for fish-farming and grazed woodlands. Outside Nigeria, the wetlands are best known as the sanctuary for migrant water birds which arrive from Europe during the winter months.

Since the wetlands are located near to the Sahara desert, they suffer regularly from severe droughts such as those of 1972-74 and the late 1980's. Droughts and desertification therefore pose a threat to the wetlands which are sometimes badly affected by severe sandstorms such as that of the 30th May 1988. The decrease in rainfall over the years has affected adversely the extent of the wetlands. Yet the human and livestock population using the wetland resources have continued to increase. The migrant birds population has also increased considerably between 1987/88 and 1989/90 when 60,000 palaertic water birds, mostly ducks and birds of tropical African origin were counted (SMITH and COULTHARD 1990: 2).

Dams and irrigation schemes are land-uses that pose additional and perhaps the greatest threat to the wetland ecosystem. Tiga dam and several irrigation schemes upstream hold or withdraw water bound for the wetlands, thereby contributing to the drying up of the wetlands. As a result, the floods are not as extensive as in the past. Reduced floods have already resulted in the degradation of the woodland in the Baturia Wetland Reserve, which consists chiefly of *Mitragyna* groundwater woodland. Since about 1987 the shrub and grass cover in the Baturia Reserve has become sparser. The degradation of the reserve is caused partly by continued grazing, fishing, farming and cutting wood, activities which are prohibited in the area.

In addition to drought, dams and upstream abstraction of water for irrigation, river course changes are a major factor in the desiccation of the wetlands. River channel engineering in the wetlands and land development within the area, which involve the opening of new water courses and improvement of natural water courses to take water to

suitable farm lands, end up reducing flood waters. This is not a healthy development for the ecology of the region because the flood waters that inundate the wetlands are not lost or wasted water. Rather much of the waters go to recharge the aquifers in the Chad formation. Reduction or total prevention of the floods have already resulted in the drying up of boreholes located far away from the rivers.

Exactly at this point of drafting this paper, on Sunday, November 22, 1992 I came across a Sunday Magazine feature article with the disturbing title 'Death of An Oasis'. It turned out to be an update presentation on the disaster that human interference with the ecosystem of the Chad Basin, especially the wetlands is about to cause in the region. In spite of several warnings to the contrary, the Nigerian government has proceeded to disrupt further the natural functioning of the Hadejia-Nguru wetlands. Although crop yields on irrigated fields fed by water from the Tiga dam in Kano is no more than 50% of what was anticipated, work has continued on the Challawa Gorge and Kafin Zaki dams which may spell death to the wetlands. The experience of the Bakolori Dam irrigation project in Sokoto State, like that of the South Chad Irrigation Project, suggests that the warnings against and the fears expressed about the water development projects in the wetlands should be taken seriously. Once the contrasts have been executed, our lack of maintenance culture and callous attitude to government property are likely to confirm the fears that the ongoing efforts to turn the wetlands into a bread basket for Nigeria may well end up in the complete desiccation and desertification of the area.

## Conclusions

In the Gezira, Africa has an enviable large scale irrigation scheme of over 40 years standing. Irrigation has also been used to green the deserts in Israel, Saudi Arabia and California to mention a few cases. In Nigeria, large scale irrigation schemes, with the possible exception of the Bacita Sugar Estate, have not yielded the desired results. Worse, still modern irrigation schemes in the Chad Basin appear to have the opposite effects. Is this one more case where the 'Nigerian factor' is at work? It may well be true that 'the motive for irrigation development in Nigeria is more political than economic, commercial or technical'. But this does not and cannot explain the success of the Gezira and the failure of the Lake Chad irrigation schemes.

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